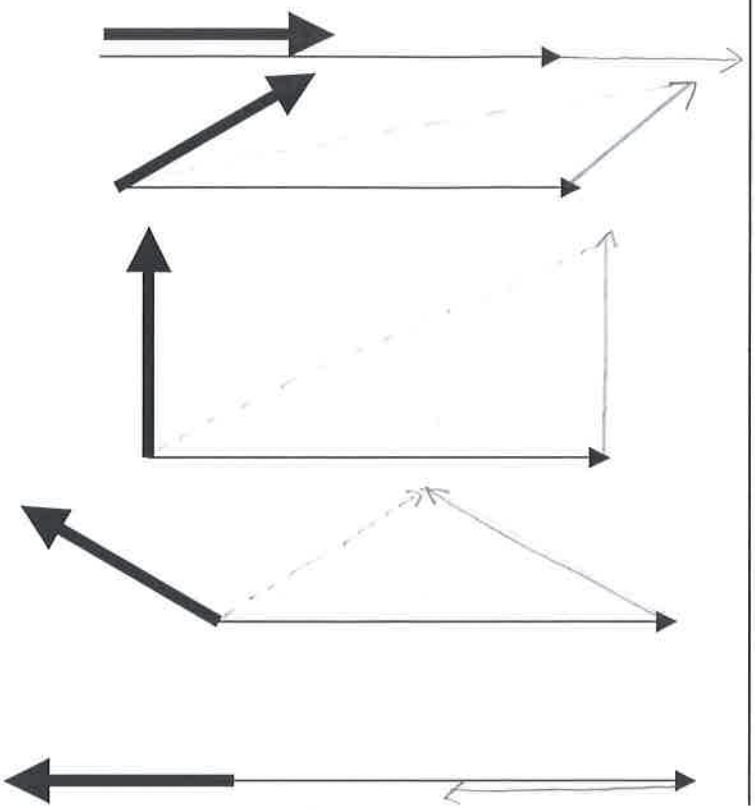
Sketch the resultant of the concurrent vectors below.



Based on the results of your drawings at left, answer the following questions:

1. What is the relationship between the magnitude of the resultant and the angle between the concurrent vectors?

As the angle of concurrent vectors increases and approaches 180°, the magnitude of the resultant vector decreases.

2. What angle between concurrent vectors gives a :

a) maximum resultant ? $\emptyset^\circ$

b) minimum resultant? 180°

3. Two forces of 12 N and 4 N act concurrently on an object. What are the possible values for the resultant force? Sketch vector diagrams to support your answer.

max angle = $\emptyset^\circ$

12N + 4N = 16N

12N + 4N = 8N angle = 180° min

or -12N + -4N = -16N

or -12N + 4N = -8N

http://www.walter-fendt.de/ph11e/resultant.htm
http://physics.bu.edu/~duffy/java/VectorAdd.html

Resolving a Vector into Components

1. Prof. Einstein walked 13.6 m in a direction 55.0° north of east as shown.

a) How far did he travel north?

b) How far did he travel east?

$\vec{d}_y = \vec{d}\sin\theta$

$\vec{d}_x = \vec{d}\cos\theta$

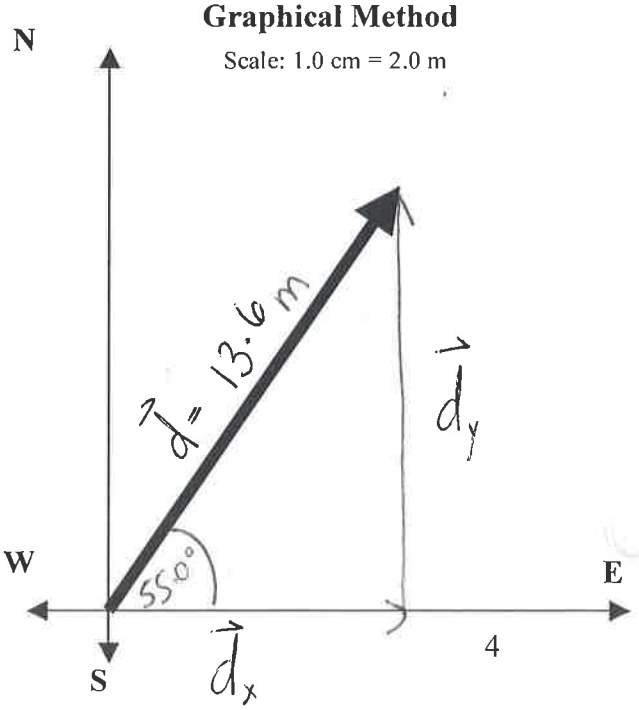
Mathematical Method

a.) $\vec{d}_y \sin 55^\circ = \frac{\vec{d}_y}{13.6\text{m}} = 11.1\text{m}$

b.) $\vec{d}_x = 105\,55^\circ = \frac{\vec{d}_x}{13.6\text{m}} = 7.80\text{m}$

Graphical Method

Scale: 1.0 cm = 2.0 m



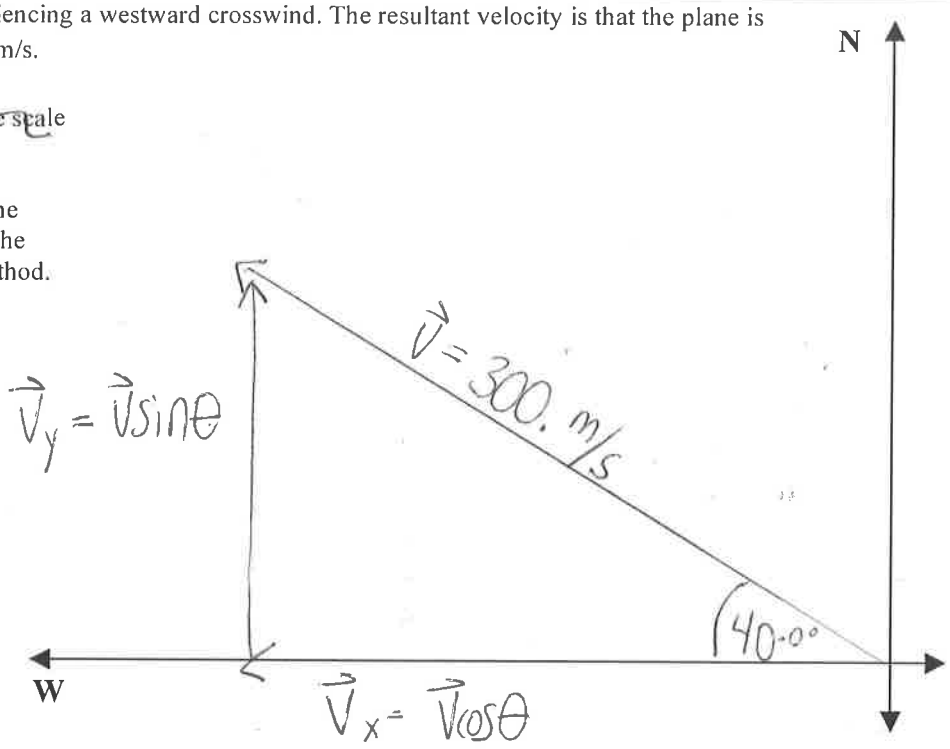
2. A plane attempting to head due north is experiencing a westward crosswind. The resultant velocity is that the plane is heading 40.0° north of west at a speed of 300. m/s.

a) Draw the resultant velocity vector using the scale of 1.0 cm = 50. m/s.

b) Determine the component velocities (i.e. the plane's speed and the wind's speed) using the graphical method and the mathematical method.

plane's $\vec{V}_y = 193 \frac{m}{s}$

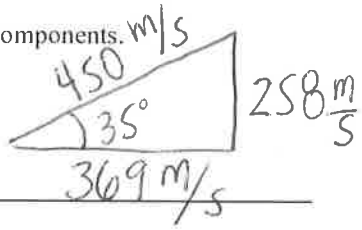
wind's $\vec{V}_x = 230. \frac{m}{s}$



3. A cannonball is launched with a speed of 450 m/s at an angle of 35° above the horizontal.

a) Sketch an appropriate vector diagram showing the resultant velocity and its horizontal and vertical components. *(Diagram does not need to be drawn to scale but should be roughly to scale.)*

b) Calculate the horizontal and vertical components of the cannonball's velocity.



4. A person drags a crate across the floor with a force of 200. N at an angle of 20.°above the horizontal as shown (not to scale).

a) Sketch an appropriate vector diagram showing the horizontal and vertical components of the force.

b) As the angle of the force increases, what will happen to the:

i) resultant force?

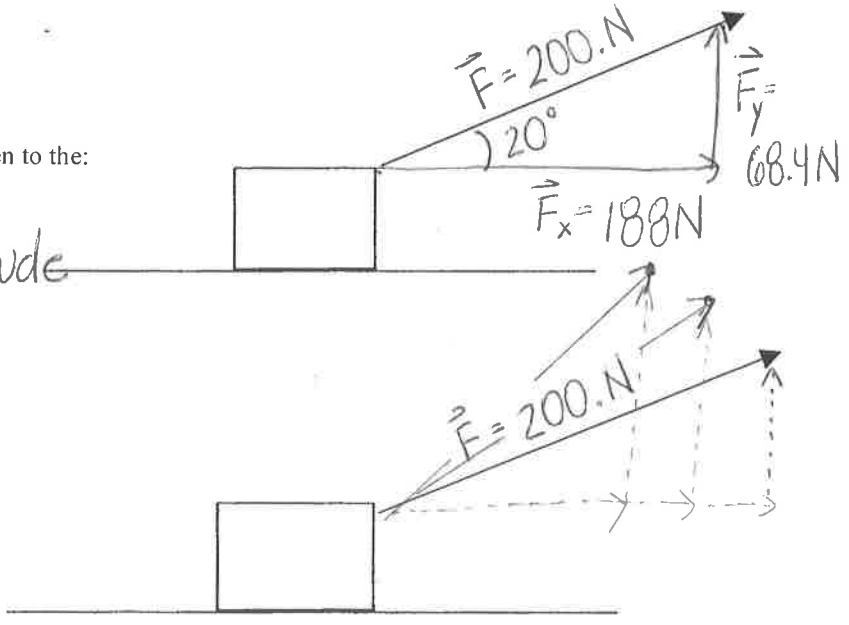
remains the same magnitude

ii) horizontal component of the force?

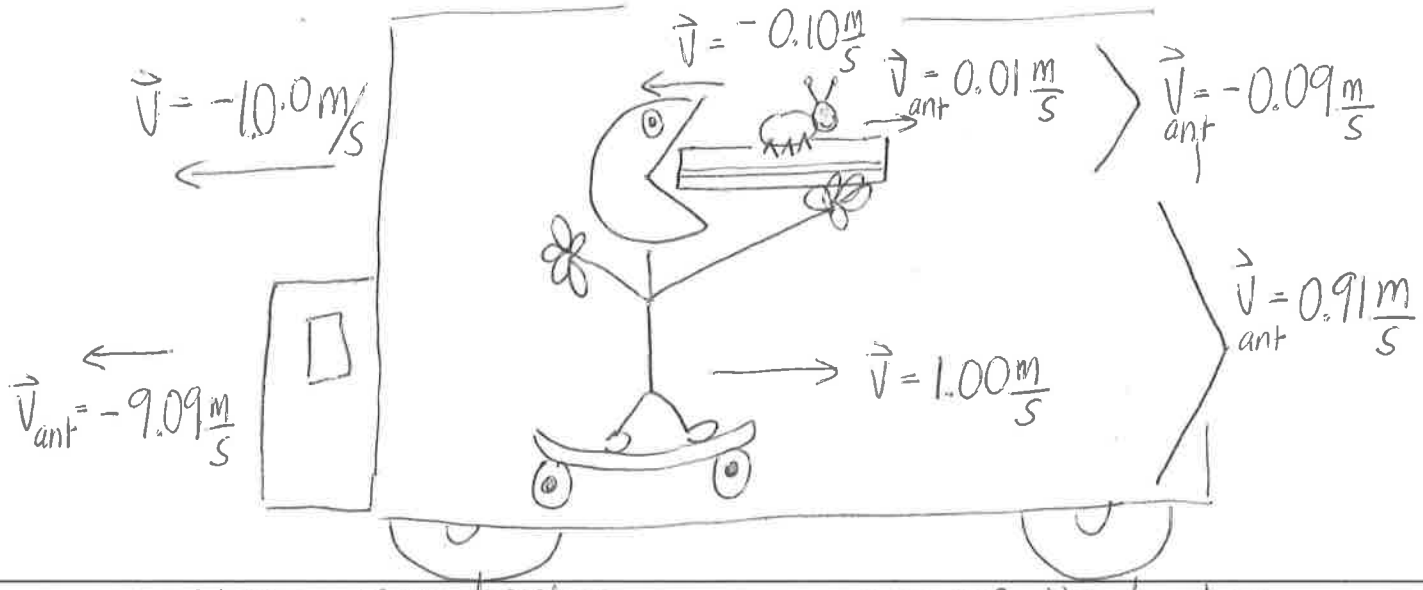
decreases

iii) vertical component of the force?

increases



Relative Velocity ⊖ ⟷ ⊕



General Rule: moving in same direction subtract velocities (speed) magnitudes ↑ moving opposite directions add velocities (speed) magnitudes ↑

1. Two cars are 400 meters apart and traveling toward each other on a long straight road. One car is moving at 30 m/s and the other at 50 m/s. How long will it take before they meet?

400m
→ 50m/s → 30m/s

a) moving same direction - subtract speeds

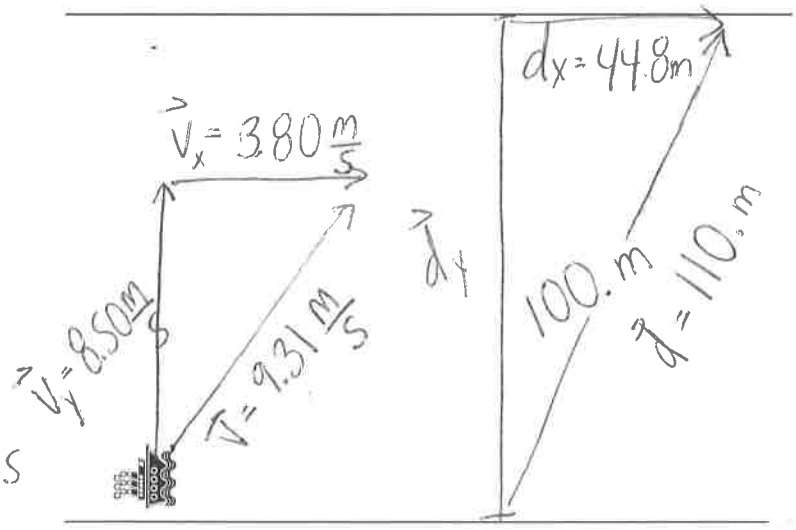
b) moving opposite direction - add speeds

→ 50m/s ← 30m/s

Independence of Vectors

2. A motorboat travels at 8.50 m/s, north straight across a river that has a current of 3.80 m/s east.

North shore



South shore

a) Determine the boat's resultant velocity.

$\vec{V} = \sqrt{\vec{V}_y^{\,2} + \vec{V}_x^{\,2}} = 9.31\ \frac{m}{s}$

b) If the river is 100. m wide, how long it will take the boat to cross the river?

$\vec{d}_y = \vec{V}_y t + \frac{1}{2}\vec{a}t^2$ (ø) $\quad \frac{100.m}{8.50\ \frac{m}{s}} = t \quad t = 11.8s$

c) How far downstream will the boat be when it reaches the opposite shore?

$\vec{d}_x = \vec{V}_x t + \frac{1}{2}\vec{a}t^2$ (ø) $\quad \vec{d}_x = (3.8\ m/s)(11.8s) = 44.8m$

d) How far will the boat actually travel?

$\vec{d} = \sqrt{d_y^2 + d_x^2} = 110.m$

http://www.surendranath.org/Applets.html